Leaf litter production in a bottomland hardwood forest

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Introduction

Bottomland hardwood forests are located along the riparian strip between rivers and upland forests. Odum (1981) described them as ecotones located between aquatic and upland systems. They contain unique tree species that are flood tolerant and provide diverse habitat for wildlife, improve water quality and lessen the severity of floods.

Historically humans have negatively impacted bottomlands by clearing and draining them for agriculture and development. Soils left behind are very fertile and produce high yields of crops. To counter act the loss of the "sponges," humans have built dams, levees and dikes to control the flow and direction of floodwaters. Along rivers that are channelized and diked, bottomlands do not have a regular flooding regime and many major ecological functions are altered, including a reduction of productivity (Odum, 1978).

Bottomland hardwood forests are considered one of the most productive ecosystems in the world because the river/stream provides a constant source of water and nutrients. Measuring the leaf litter production provides a preliminary way of determining the integrity of a forested ecosystem. The health can be determined by comparing the leaf litter production to other bottomland hardwood forests.

Methods

Site Description

The Olentangy River Wetland Research Park (ORW) is located north of the Ohio State University main campus in Franklin County, Ohio. The bottomland hardwood forest is 25 to 90 m wide and is approximately 700 m long (Figure 1). This site currently has a dike at the north end, approximately 3 m tall and 250 m long, which diverts the river away from the bottomland forest. This site is actually flooded only during exceptional floods, which in 1999 totaled four all occurring during winter and spring. The ORW site is scheduled to have the hydrology partially restored in the year 2000. Box Elder (*Acer negundo*) (FAC+), Eastern Cottonwood (*Populus deltoides*) (FAC) and American Sycamore (*Platanus occidentalis*) (FACW-) dominate this site (Dudek et al., 1998). There are also high populations of Pawpaw (*Asimina triloba*) (FACU+) and Ohio Buckeye (*Aescules glabia*) (FACU+) (Bouchard and Mitsch, 1999).

Sampling Methodologies

Transects were established along the elevation gradient, perpendicular to the river. Eight litter stations were established along the transects to represent a variety of topography, from low (towards the river) to high (towards the upland area) elevations. Stations one, six and eight are classified as "wet" stations because the soils are delineated as wetland soils (Acton et al., 1998).

Litter Production

Leaf litter was collected at eight stations inside the bottomland forest (Figure 1). Leaf litter traps were placed randomly inside each station along the transects. The litter traps are 15 cm tall with a mesh screen bottom and have an area of 0.24 m^2. These traps were collected once a week during autumn months when trees lose most of their leaves (Newbould, 1967). The leaf litter was collected, dried at 105°C, and weighed to the nearest 0.1 g.

Results and Discussion

The leaf litter production per sampling station is found in Figure 2. Leaf litter production, being a measure of Net Primary Production (NPP), is expected to be higher in areas of "wet" stations because of the increased availability of water. Although litter production was higher in stations one and eight ("wet" stations), there was not a significant difference in production.

The average litterfall production of the bottomland hardwood forest was 408 ± 151 g m^{-2} (ave ± stdev). This value is lower than the reported production in the Bouchard and Mitsch (1999) study and higher than the value in the Harvan (1998) study. Bouchard and Mitsch (1999) collected leaf litter for six months, from July to December. This study collected litter for four months, from October to January. The leaf litter production re-calculated from October to January in the Bouchard and Mitsch (1999) study is 362 ± 101 g m^{-2} (ave ± stdev). These two values are very similar which suggests that the production in the bottomland remained consistent for the last two years.

One major source of error is not setting the traps early enough to collect all the litterfall. Bouchard and Mitsch (1999) started to collect litter in July, where as Harvan (1998) and this study started in October.

References

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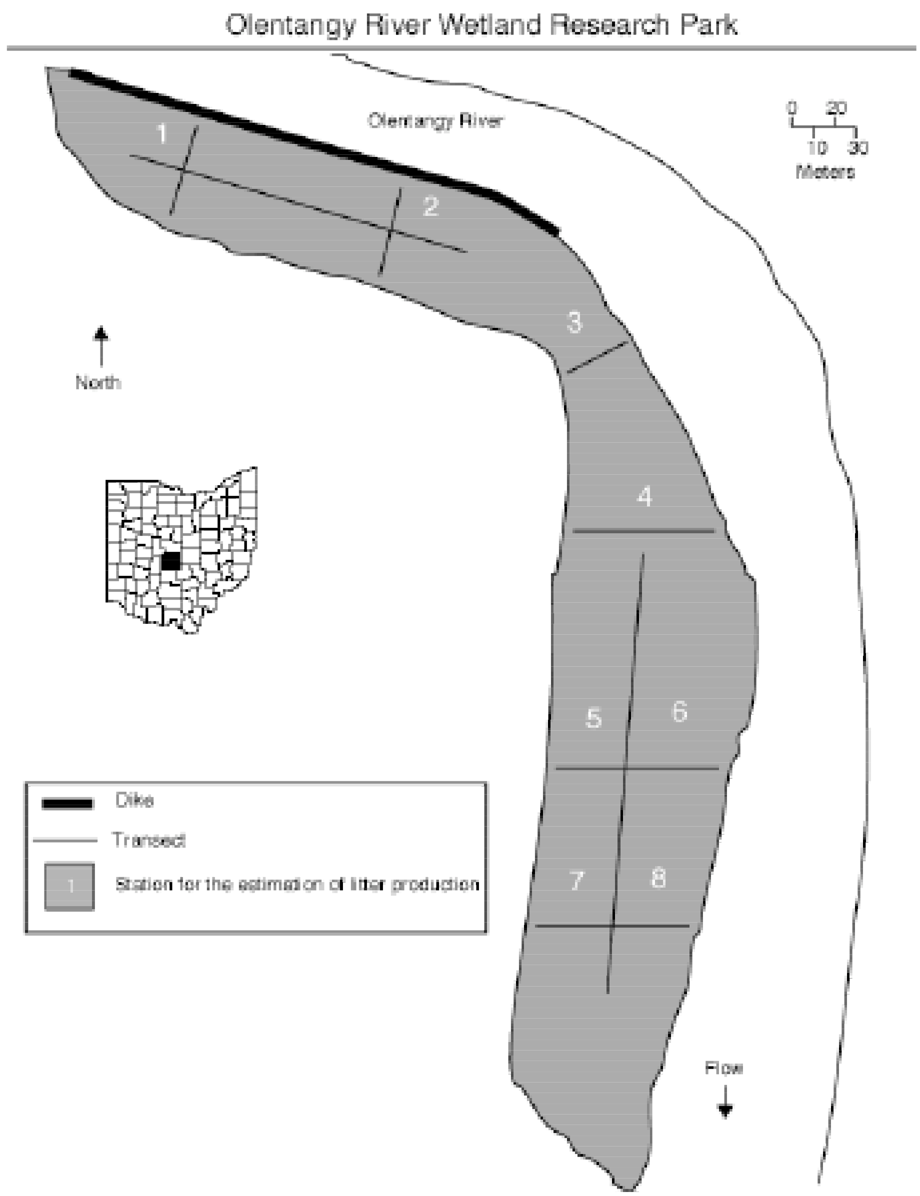

Figure 1. Map of the bottomland forest at the Olentangy River Wetland Research Park with indication of the vegetation transects.

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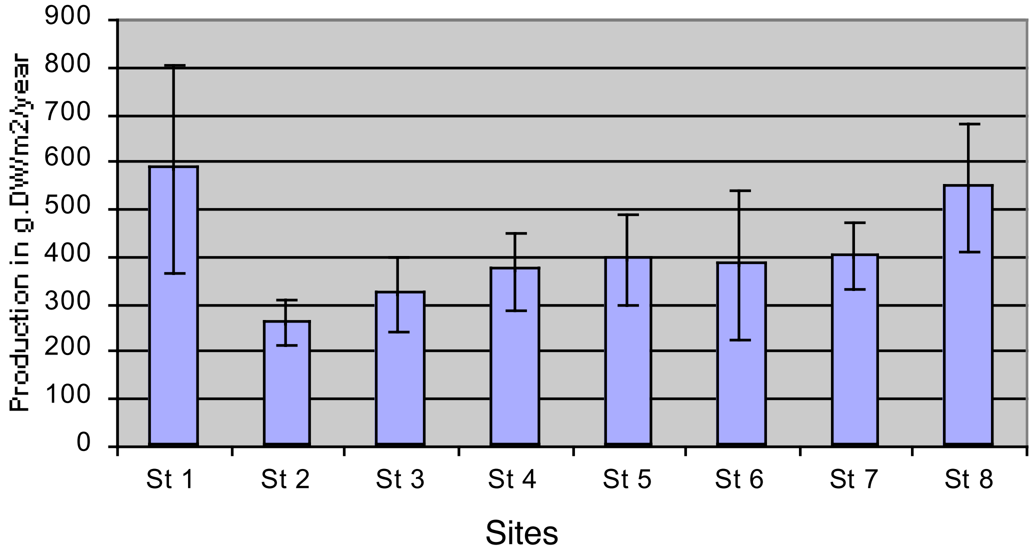

Figure 2. Leaf litter production per sampling station.

Appendix A. Production of litter in the bottomland forest 1999, raw data.

	Litter Production (g DW/m^2/yr)						
Trap #	10/18/99	11/1/99	11/8/99	11/15/99	11/22/99	12/7/99	1/5/00
1-1	20.2	26.4	22.5	6.9	3.6	0.9	4.8
1-2	36.0	53.9	35.3	14.7	13.6	1.2	4.9
1-3	33.1	59.4	28.3	36.8	15.1	3.0	45.4
1-4	55.5	44.2	19.1	4.2	1.6	1.4	0.0
1-5	32.8	21.6	19.1	1.8	2.7	6.2	26.6
2-1	20.9	9.9	0.0	2.3	2.9	5.5	6.7
2-2	24.1	11.5	7.5	8.9	3.8	8.8	8.2
2-3	28.8	14.5	8.3	8.4	3.8	6.0	5.4
2-4	29.4	15.1	4.8	1.0	3.3	2.4	4.4
2-5	25.6	10.6	2.3	3.1	5.8	2.7	4.7
3-1	24.6	19.5	17.4	23.7	9.8	7.5	5.0
3-2	19.0	5.9	6.2	8.4	4.9	8.6	4.0
3-3	32.5	9.0	5.5	5.8	8.1	8.2	4.1
3-4	25.6	24.9	9.4	5.7	6.0	5.7	3.8
3-5	30.8	7.5	4.0	7.2	8.2	8.0	3.2
4-1	34.4	9.9	2.0	2.3	2.7	1.4	10.3
4-2	47.5	15.9	10.4	5.0	1.7	16.9	2.9
4-3	30.1	22.6	12.2	7.3	15.0	19.2	4.8
4-4	28.0	28.9	15.3	6.4	4.3	7.1	5.2
4-5	40.7	13.2	5.2	3.8	4.4	2.7	5.2
5-1	24.1	23.3	8.0	14.2	1.3	2.2	2.2
5-2	23.7	36.3	24.5	8.3	2.7	1.4	7.6

	Litter Production (g DW/m^2/yr)						
Trap #	10/18/99	11/1/99	11/8/99	11/15/99	11/22/99	12/7/99	1/5/00
5-3	18.1	26.8	24.0	6.6	5.4	0.9	17.7
5-4	24.7	25.0	25.4	10.0	7.9	6.6	24.7
5-5	25.0	10.7	8.9	9.7	2.7	1.5	10.5
6-1	0.0	61.2	29.1	15.2	1.7	0.8	4.5
6-2	0.0	14.1	10.4	4.9	0.8	2.0	10.3
6-3	39.8	31.3	12.7	4.0	1.4	1.6	45.7
6-4	24.2	25.1	0.0	9.1	0.8	4.4	0.0
6-5	18.9	35.7	27.6	7.6	1.3	3.0	8.4
7-1	35.8	23.0	9.7	11.4	3.7	2.0	0.0
7-2	29.7	25.7	11.5	11.1	5.8	2.4	3.9
7-3	35.9	31.5	11.6	16.8	10.2	7.9	13.1
7-4	32.9	16.6	12.6	19.3	3.3	2.4	0.0
7-5	38.9	24.9	8.4	6.7	1.6	2.2	10.1
8-1	21.9	81.6	15.3	6.1	2.9	3.4	7.0
8-2	23.4	48.9	4.7	5.5	6.2	7.1	0.0
8-3	22.5	88.2	32.6	16.4	14.9	3.8	0.0
8-4	27.7	39.6	23.2	12.2	1.7	1.8	0.0
8-5	58.4	44.8	15.3	12.1	1.7	1.8	0.0